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APPLICATION FOR LETTERS PATENT

FOR

VANE CELL PUMP

This application claims priority to German Application No. 101 42 712.3 filed on August 31, 2001

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Vane Cell Pump

Cross Reference to Related Application

[0001] This application is a continuation of copending International Application No. PCT/DE02/03154 filed August 28, 2002 which designates the United States, and claims priority to German application no. 101 42 712.3 filed August 31, 2001.

Technical Field of the Invention

[0002] The invention relates to a vane cell pump for delivering fluids and in particular a vane cell pump which is used as a pre-supply unit for a common rail fuel injection system in motor vehicles.

Description of the Related Art

[0003] In reservoir-type fuel injection systems for motor vehicles, such as common rail systems, a pre-supply pump is normally used in addition to a high-pressure pump. The pre-supply pumps employed for this purpose are generally vane cell pumps capable of providing the necessary flow displacement and a corresponding pressure increase, said vane cell pumps in particular being capable of ensuring the necessary operating points relatively well even at very low speeds (starter motor speed), the known vane cell pumps being made from metal materials.

[0004] However, the disadvantage of the known vane cell pumps is that, at the relatively low speeds of approximately 75 RPM during starting of a motor vehicle, the centrifugal force of the vanes alone is insufficient to ensure that the vanes bear tightly against a corresponding cam contour of a ring of the pump. This produces a delayed pressure build-up or leaks resulting in efficiency losses during starting of the motor vehicle and therefore making the vehicle more difficult or in some cases impossible to start. Moreover, it is possible that, at very high vane cell pump speeds, flow pulsations occur causing the vanes to partly lift in partial angular regions of the cam contour.

Summary of the Invention

[0005] The object of the present invention is therefore to provide a vane cell pump that is of simple construction and easy and inexpensive to manufacture, and which ensures that the vanes bear tightly against a cam contour element.

[0006] According to the invention this object can be achieved by a vane cell pump for delivering fluids, comprising a rotor, a cam ring and a plurality of vanes which are pre-tensioned by means of spring elements, the spring elements being an integral part of the rotor, wherein the rotor is made of plastic and the spring elements are captively molded into the rotor.

[0007] The object can also be achieved by a vane cell pump for delivering fluids, comprising a plastic rotor having integrated spring elements captively molded into the rotor, a cam ring, and a plurality of vanes whereby the vanes are pre-tensioned by said spring elements.

[0008] The spring elements can be implemented as spring tongues or as spiral springs. The spring elements can be disposed on a ring. The spring elements can be made of spring steel or plastic. The vanes and/or the cam ring and/or a side plate and/or a pump casing can be made of plastic. A duroplast can be used as the plastic material. The vane cell pump can be used as a pre-supply pump for a high-pressure pump of a common rail injection system.

[0009] The vane cell pump according to the invention for delivering fluids ensures that, irrespective of the speed, the vanes bear continuously against a ring providing the cam contour of the pump. To achieve this, each vane is pre-tensioned outward by means of a spring element so that the vane bears continuously against the ring contour, the spring elements being implemented in such a way that they are an integral part of the pump rotor. This means that the spring elements are captively connected to the rotor so that significant cost reductions can be achieved particularly in terms of pump assembly. By means of this one-piece implementation of rotor and

spring elements, during the assembly process the rotor with incorporated spring elements can easily be assembled as a sub-module, thereby obviating the need for laboriously placing individual spring elements in the rotor.

[0010] It is particularly preferred that the rotor is made of plastic and the spring elements are captively molded into the rotor, thereby enabling the rotor in particular to be manufactured particularly inexpensively. This combined with the assembly advantages provides a cost reduction of over 40% compared to conventional vane cell pumps made of metal. In particular, through the use of plastic, the machining operations necessary in the case of metal materials can also be significantly reduced. Using plastic for the rotor in particular makes it possible to ensure that the spring elements are captively molded into the rotor in such a way that no discontinuity is created in the rotor end faces. This ensures a homogeneous radial sealing length of the rotor to the adjacent parts of the pump.

[0011] Spring tongues or spiral springs are preferable used as spring elements, said spring elements being disposed in such a way that they are positioned in the bottom of slots in which the vanes move, so that the vanes are pre-tensioned outward by the spring elements.

[0012] According to a particularly preferred embodiment of the present invention, the spring elements are mounted on a ring, thereby enabling said spring elements likewise to be provided as a module. The spring elements are disposed on the outer circumference of the ring and project outward. This considerably simplifies in particular the positioning of the spring elements, e.g. for molding of the rotor.

[0013] More advantageously still, the spring elements can be made from spring steel or plastic. If the spring elements and the rotor are made of plastic, the spring elements can be molded simultaneously with the rotor (particularly preferred), thereby enabling further cost reductions to be achieved.

[0014] In order also to achieve manufacturing cost reductions for other components of the vane cell pump, the vanes and/or the cam ring and/or a side plate and/or a pump casing can be made from plastic, in particular a duroplast preferably being used as the plastic material.

[0015] The vane cell pump according to the invention is preferably used in particular as a pre-supply pump for a reservoir-type fuel injection system such as a common rail system.

Brief Description of the Drawings

[0016] A preferred embodiment of a vane cell pump according to the present invention will now be described with reference to the accompanying drawings in which:

[0017] **Figure 1** shows a schematic cross-sectional view of a vane cell pump according to an embodiment of the present invention;

[0018] **Figure 2** shows a schematic side view of the main components of the vane cell pump shown in Figure 1;

[0019] **Figure 3** shows a cross-sectional view along the line B-B of Figure 2;

[0020] **Figure 4** shows a cross-sectional view along the line A-A of Figure 3;

[0021] **Figure 5** shows a partial cross-sectional view along the line C-C in Figure 2;

[0022] **Figure 6** shows a perspective view of the spring element component; and

[0023] **Figure 7** shows a perspective exploded view of the main components of the vane cell pump.

Detailed Description of the Preferred Embodiments

[0024] An embodiment of the present invention will now be described with reference to Figures 1 to 7.

[0025] As shown in Figure 1, the vane cell pump comprises a rotor 2 which is driven in the known manner via a drive shaft 9. As shown in Figures 4 and 7, the rotor 2 contains a plurality of slots 10 in each of which there is disposed a vane 4, the vanes 4 moving in the radially formed slots 10.

[0026] As can be see from Figures 2 and 4, the rotor 2 is disposed in a cam contour element implemented as a ring 3. As depicted in Figure 1, the cam ring 3 is an integral part of a casing 8 of the vane cell pump. Note, however, that the cam ring 3 can also be implemented as a separate component. The cam ring 3 is disposed eccentrically to the rotor 2 so that the individual vanes form separate pump chambers in the known manner.

[0027] As can be seen particularly from Figures 2 and 3, a spring component comprising a spring ring 6 and spring elements 5 disposed thereon additionally forms an integral part of the rotor 2. Figure 6 shows a perspective view of the spring component. The spring elements 5 are disposed on the outer circumference of the ring 6 and provide a spring force in the radial direction of the ring 6. The spring component is made from spring steel and can be easily manufactured by punching out and bending over the spring elements 5 by approximately 90° with respect to the ring surface.

[0028] The spring elements 5 are disposed in the slots 10 of the rotor 2 in such a way that they pre-tension the vanes 4 radially outward, thereby ensuring that the vanes 4 bear against the contour of the ring 3 in every position and at all speeds of the rotor 2 (cf. Figure 2), the rotor 2 being made of plastic and the spring component being completely molded into the rotor as a pre-fabricated module. This implementation of the rotor additionally ensures that the two rotor end faces S, T (cf.

Figure 3) are homogeneously formed so as to ensure reliable sealing with respect to adjacent components of the vane cell pump, e.g. to the casing 8 and to a side plate 7 (cf. Figure 1).

[0029] The use of annular spring components with a plurality of spring elements therefore ensures that the vanes 4 constantly bear against the cam contour and therefore no efficiency losses occur even during engine starting at low RPM. This also minimizes any lifting of the vanes at high engine speeds and the associated flow pulsations, the spring elements 5 supporting the reverse hydraulic loading of the vanes 4.

[0030] In addition, as the spring elements 5 are an integral part of the rotor 2, the assembly costs in particular can also be significantly reduced, as no time-consuming positioning of the spring elements in the slots 10 of the rotor 2 is necessary. In particular a flow rate necessary during starting for a high-pressure pump of a common-rail injection system for motor vehicles can therefore be provided according to the invention. Particularly by using plastic as the material for components of the vane cell pump a surprisingly high manufacturing cost saving can be achieved compared to known vane cell pumps comprising metal components. The inventive combination of integral spring elements in a rotor of the vane cell pump therefore provides major competitive advantages.

[0031] The present invention therefore relates to a vane cell pump for delivering fluids, comprising a rotor 2, a cam ring 3 and a plurality of vanes 4 which are pre-tensioned by means of spring elements 5, the spring elements 5 being an integral part of the rotor.

[0032] The present invention is not limited to the embodiment described. Various variations and changes can be made without departing from the scope of the invention.